Renewable Energy Multi-Client Study: *The Changing Face of Renewable Energy*

Report Outline

Participants:
We Energies
Ontario Power Generation
ARC Financial
National Renewable Energy Lab
Salt River Project
Southern Company
Los Angeles Department of Water & Power
San Francisco Public Utilities Commission
Hydro Quebec
Confidential Client

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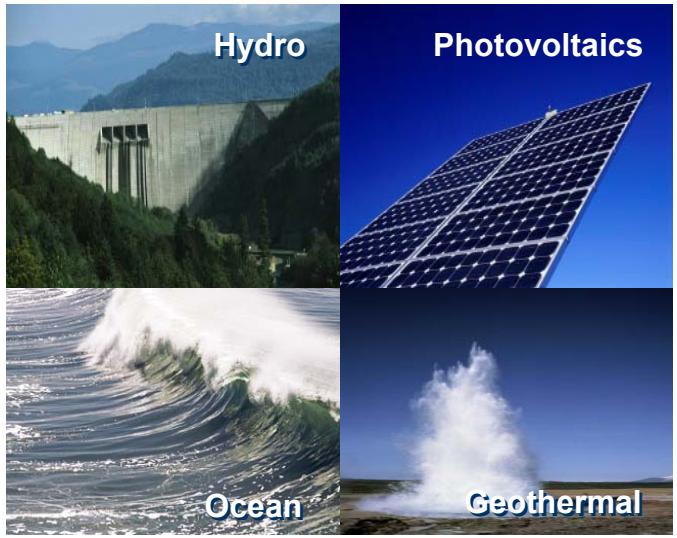
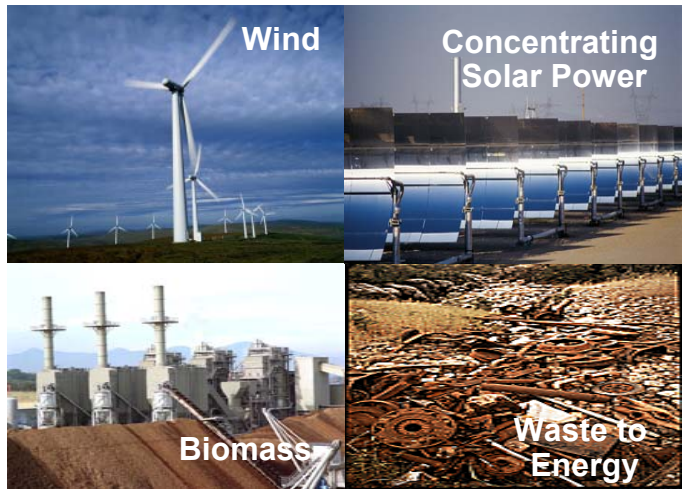
CONSULTING, INC.





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Renewable Energy Multiclient Scope of Study

	Executive Summary
1.	Technology Cost, Performance, and Markets
2.	Renewable Energy Grid Integration
3.	Certificate/Attribute and Emission Trading
4.	Renewable Portfolio Standards
5.	Subsidies and Renewable Energy Funds
6.	Green Energy Business Issues
7.	Permitting/Net Metering/Buyback Rates

The technology section of the final report will give detailed attention to the following technologies.

Technology Focus Areas	
Primary	**Secondary**
• **Large On-Shore Wind** • **Off-Shore Wind (Ocean, Great Lakes)** • **Biomass Power** – **Gasification** – **Co-firing** – **Digester Gas (e.g., animal waste)** – **Landfill Gas** • **PV (flat plate – wafer and thin films)** • **Low Impact Hydro (< 5MW)**	• **Concentrating Solar Power** • **Geothermal** • **Storage** **Tertiary** **(high level, long-term key developments only)** • **Tidal** • **Wave** • **Nano Solar Cells**

Inverters: NCI will present current and projected costs, general performance data, and profile the top three suppliers to the PV industry for grid-connected systems

For each primary and secondary technology, NCI will cover technology performance, price, and market drivers and barrier issues.

Technologies –Topic Areas and Level of Focus		
Topic Areas	**Primary Technologies**	**Secondary Technologies**
• Technology Performance in (2003 – 2013) – System Electrical Efficiency – Duty Cycle and Capacity Factor – Expected Lifetime – O&M Requirements – Typical Size – Typical Emissions – Other Performance Issues (e.g. noise, water use)	●	●
• Economics (2003 – 2013)	●	●
• Market Drivers & Barriers (e.g., land use)	●	●
• Market Size or Technical Potential (U.S./Canada/Europe (PV, wind)/ World) – MW/yr for 2002 – 2013	●	
• Key Players – Manufacturers, developers, owner/operators – Overview, Strengths, and Weaknesses	●	

A table similar to the one below will be used to document technology performance characteristics.

Flat Plate Photovoltaics						
Characteristics	**2003**		**2008**		**2013**	
	Wafer	**Thin Films**	**Wafer**	**Thin Films**	**Wafer**	**Thin Films**
System Electrical Efficiency (%)						
Equipment Life (yrs)						
Typical Emissions (grams/kWh) CO_2 SO_2 NO_x						
Duty Cycle (hrs/yr)						
Typical Size						
Maintenance Requirements						

Illustrative

Sources: **Assumptions:**

For each technology, we will also estimate levelized costs and provide the associated assumptions for 2003-2013.

Wind Energy	2003	2008	2013
Typical Size (kW)	TBD	TBD	TBD
Installed System Price ($/kW)[1]	TBD	TBD	TBD
O&M Costs ($/kW-yr)[1]	TBD	TBD	TBD
System AC Output (kWh/kW-yr) High Wind Speed Area[2] Moderate Wind Speed Area[3] Low Wind Speed Area	 TBD TBD	 TBD TBD	 TBD TBD
Cost of Electricity (¢/kWh) [5,6] High Wind Speed Area[1] Moderate Wind Speed Area[2] Low Wind Speed Area[4]	 TBD TBD TBD	 TBD TBD TBD	 TBD TBD TBD

Illustrative

Notes:
1. Real 2003 $.
2. Capacity Factor for Class 6 Winds (8m/s or 17.9mph @ 50m hub height) = 38% 2002, 40% 2005, 43% in 2010.
3. Capacity Factor for Class 4 Winds (7m/s or 15.7mph @ 50m hub height) = 30% 2002, 32% 2005, 35% in 2010.
4. Capacity Factor for Class 3 Winds
5. To be based upon agreed to financial assumptions
6. Levelized busbar costs

We will use real data when available for 2003 and provide forecasts based on NCI analysis and industry interviews.

Key market drivers and barriers will be defined for key market segments.

Flat Plate Photovoltaics		
Segments	**Market Drivers**	**Market Barriers**
Grid-Connected Central	• TBD	• TBD
Residential Rooftop	• TBD	• TBD
Building Shingles	• TBD	• TBD
Commercial Rooftop	• TBD	• TBD
Curtainwall	• TBD	• TBD

For the primary technologies, we will provide company profiles of the top 3 players for each technology for each major step of the value chain.

	Manufacturer	Integrator /Installer	Project Developer	Project Owner/ Operator
Wind	●		●	●
Biomass (gasification, co-firing, landfill gas, digester gas)*	●			
Flat Plate PV	●	●		
Inverters	●			
Low Impact Hydro (<5MW)	●			

*Due to the emerging and fragmented nature of this segment, NCI will provide a listing of the key technology providers/developers for each of these four subcategories and will provide high-level profiles for the top two manufacturers in each subcategory.

A sample template for the type of company information to be provided is presented below.

NEG Micon - Manufacturer

Company Overview

Business Strategy
- If Project Owner/Developer discuss ownership structure e.g. PPA or equity positions

Commercial Advantages
- TBD

Product Focus
- TBD

Markets/Geographic Focus
- TBD

Other Information
- Typical Revenues/Sales (MW/yr.)
- Market Position

Illustrative

Competitiveness of Products

Strengths	*Weaknesses*
• TBD	• TBD

Renewable energy grid integration will address market and technical aspects of interconnecting intermittent resources to the grid.

Renewable Energy Grid Integration	
Variability	**Storage**
• Review technical impacts of output variability on transmission and distribution systems • Assess market cost and resource planning implications of connecting intermittent generators • Examine lessons learned from the past through case studies of North America, Europe, and Australia experience • Identify and characterize successful market and technical integration practices	• Discuss storage issues relative to intermittency/variability • Review current and upcoming technical options (e.g. flow batteries, compressed air storage, hydrogen) that could minimize or eliminate variability issues • Provide high-level discussion of hybrid systems • Examine market drivers/barriers • Discuss storage impact on value
Interconnection	
• High level review of interconnection issues	

Certificate/attribute and emission trading will review rules and regulations, market drivers, certificate value price ranges, and market trends.

Certificates/Attribute and Emission Trading

- Review EU, U.S. & Canada certificate program status and trends (2003 – 2008)
- Identify regulatory and market drivers
- Discuss the range of possible REC and emission values under different conditions (2003-2013)
- Describe structure/fees/market mechanisms for programs
- Assess implications for utility resource planning
- Assess implications for regulated vs. competitive markets
- Assess RECs impact on renewable energy market growth in the U.S. and Canada
- Describe the types of certifying groups available
- Discuss interplay between RECs and emission trading markets, including CO_2
- Describe the impact of following Kyoto Protocol and what that will mean for renewables
- Assess green tags distinctions for technologies (e.g., green tags are not equal for PV vs. landfill gas)
- Assess implications and sustainability of green tags over long term

The study will also assess the status and projections for Renewable Portfolio Standards in the U.S. and Canada.

Renewable Portfolio Standards

- Review the status and projections for RPS in the U.S. and Canada
- Review how costs for meeting RPS are being recovered by munis, IOUs
  - In regulated and unregulated markets
- Assess the longevity of these regulatory schemes
- Review different State and Provincial standards and their focus areas
  - Present successes and lessons learned to date
  - Define elements of a successful RPS
- Discuss the likelihood of a Federal RPS in the U.S. and how it might affect State RPSs
  - What would a good Federal RPS look like
  - How would it vary geographically & what would be the regional affects (e.g., one size does not fit all)
- Identify various cost impact models that are available
- Assess trends as to what technologies are defined as eligible renewables
- Review the issue of supply vs. demand (e.g., supplying a product that no one wants to buy)
- Does a RPS go against the rules of NAFTA? Are there inconsistencies?

NCI will characterize U.S. renewable energy funds and assess the impact of typical subsidies.

Subsidies and Renewable Energy Funds

- **Provide a high-level review of U.S. state renewable energy funds**
- **Assess the value and impact of typical subsidies**
  - **What are typical State or Provincial level subsidies and how do they impact renewable energy economics?**
  - **What incentives are available at the Federal level and what would be the impact on renewable energy economics of proposed legislation?**

NCI will identify renewable energy business model options.

Green Energy Business Issues

- **Define clean vs. green vs. renewable**
- **Identify renewable energy business model options that are available**
  - **Should companies accept a lower return to include renewable energy in their portfolios?**
  - **What are the advantages of various commercial approaches?**
    - **Ownership structure, power purchase agreements, debt/equity structure**
- **Identify sources for assessing lessons learned from voluntary green power programs**

We will review regulatory issues such as permitting, net metering, and buy-back rates.

Permitting/Net Metering/Buyback Rates

- **Permitting issues**
  - **What are successful ways States/Provinces have dealt with permitting?**
  - **Regulatory regimes are old and do not effectively address new issues and priorities (e.g. local permitting vs. Kyoto requirements)**
- **Net metering – Buy-back rates**
  - **Provide a matrix showing preferred mechanisms by technology and by size**
  - **Identify "Best Practices"**